EWM22M-xxxT22S Product Specification

AT Command 22dBm Small Size LoRa Wireless Module



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1 Introduction

1.1 Brief Introduction

EWM22M-xxxT22S is an ultra-small-sized low-cost wireless serial module (UART) with multiple transmission modes. It adopts LORA communication technology which is fully compatible and interoperable with the E22, with a maximum transmitting power of 22dBm, and operates in the 400-band or 900-band. Adopting LoRa spread spectrum technology, TTL level output, compatible with 3.3V IO port voltage.

EWM22M-xxxT22S is faster, with lower power consumption and smaller size; it supports Wake-on-Air, Wireless Configuration, Channel Listening, Automatic Relay Networking, Communication Key, etc. It supports sub-packet length setting and can provide customised development services. The three modules in the figure below have the same power and different frequency bands.

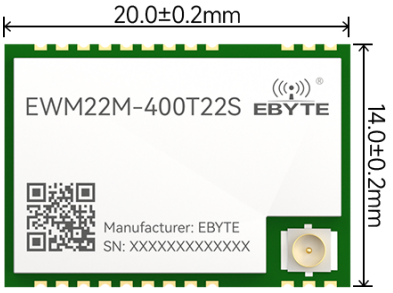


Figure 1：EWM22M-400T22S

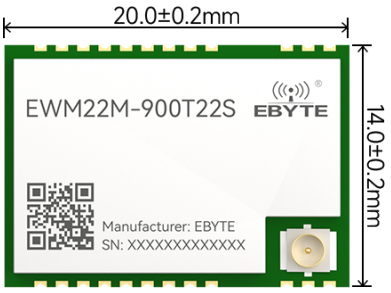


Figure 2：EWM22M-900T22S

1.2 Features

- T Adopts a new generation of LoRa spread spectrum modulation technology, which brings longer communication distance and stronger anti-interference ability;
- M Supports serial port to upgrade firmware, which makes updating firmware more convenient;
- B Supports AT command, which is more convenient to use;
- B Support automatic relay networking, multi-level relay applicable to ultra-long-distance communication, the same area to run multiple networks running at the same time;
- S Supports users to set their own communication key, and cannot be read, which greatly improves the confidentiality of user data;
- B Supports LBT function, which listens to the channel environmental noise before sending, which can greatly improve the success rate of communication of the module in poor environment;
- R Supports RSSI signal strength indication function, which is used to evaluate signal quality, improve communication network, and range measurement;
- Support wireless parameter configuration, through wireless sending command packet, remote configuration or read wireless module parameters;
- I Supports Wake-on-Air, i.e. ultra-low power consumption function, suitable for battery-powered application solutions;
- I Supports fixed-point transmission, broadcast transmission and channel listening;

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- Supports deep sleep, the whole machine power consumption is about 3uA in this mode;
- The communication distance can reach 5km under ideal conditions;
- Parameters are saved after power down, and the module will work according to the set parameters after power up again;
- High-efficiency watchdog design, once an abnormality occurs, the module will restart automatically and continue to work according to the previous parameter settings;
- EWM22M-400T22S and EWM22M-900T22S support 2.4K~62.5Kbps data transmission rate;
- Supports 2.7~5.5V power supply, and any power supply greater than 3.3V can ensure the best performance;
- Industrial-grade standard design, support -40 ~ +85 ℃ long time use;
- Module power up to 160mW (22dBm), transmission farther and more stable.

1.3 Application

- Home security alarms and remote keyless entry;
- Smart home as well as industrial sensors, etc;
- Wireless alarm security systems;
- Building automation solutions;
- Wireless industrial grade remote controls;
- Healthcare products;
- Advanced Meter Reading Architecture (AMI).

2 Specification and parameter

2.1 RF parameter

RF parameter	Unit	Model		Notice
		EWM22M-400T22S	EWM22M-900T22S	
Maximum Transmit Power	dBm	22.0±1	22.0±1	-
Receiver sensitivity	dBm	-130	-130	Air rate of 2.4kbps
Reference distance	M	5K	5K	Clear and open, antenna gain 5dBi, antenna height 2.5 metres, air rate 2.4kbps.
operating frequency	MHz	410.125～493.125MHz	850.125～930.125MHz	Supports ISM bands
Airspeed	bps	2.4K～62.5K	2.4K～62.5K	User Programmed Controls
Blocking power	dBm	10	10	Less likely to burn out in close proximity
Launch length	Btye	240	240	Packetised 32/64/128/240 byte sends can be set by command

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2.2 Electrical Parameter

Electrical Parameter		Unit	Model		Notice
			EWM22M-400T22S	EWM22M-900T22S	
Operating voltage		V	2.7～5.5	2.7～5.5	≥3.3V guarantees output power, 5V typical, over 5.5V permanently fires module。
Communications level		V	3.3V	3.3V	Risk of burn-in using 5V TTL
Power consumption	Transmit current	mA	110	120	Instantaneous power consumption @22dBm
	Receive Current	mA	8	8	
	Sleep Current	uA	3	3	software shutdown
Operating temperature		℃	-40～+85		Industrial-grade design

2.3 Hardware parameter

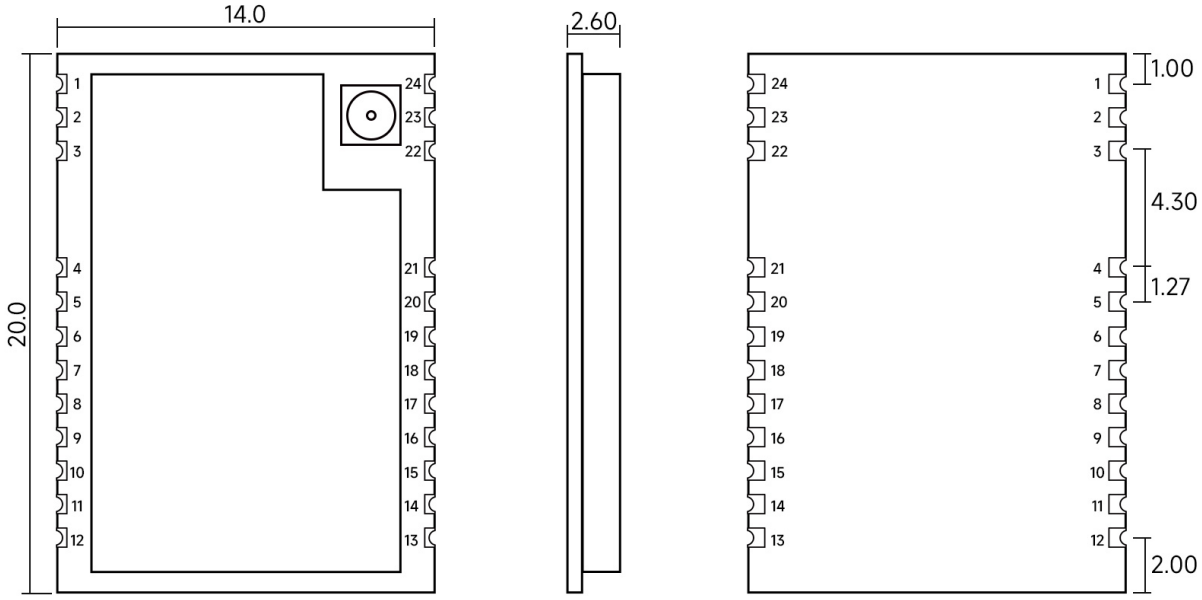
Hardware parameter	Model		Notice
	EWM22M-400T22S	EWM22M-900T22S	
Crystal frequency	32MHz		Industrial Grade High Precision Crystals
Modulation method	LoRa		LoRa modulation technology
Interface method	1.27mm stamp hole		Stamp holes, 1.27mm apart
Communications interface	UART		TTL level
Transmit Length	240 Btye		Packetised 32/64/128/240 byte sends can be set by command
Package	SMD		-
cache capacity	1000Btye		-
Antenna Interface	IPEX-1/Stamp Hole		Equivalent impedance approx. 50Ω
Size	14 * 20 mm		±0.1mm
Net Weight	1.95g		±0.05g

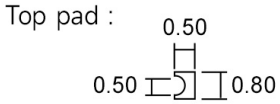
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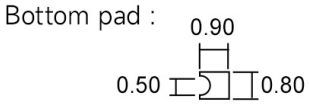
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3 Mechanical Dimensions and Pin Definitions

3.1 EWM22M-400/900T22S Mechanical Dimensions and Pin Definitions







Unit : mm
Pad quantity : 24
Tolerance value : X.X±0.2mm
X.XX±0.05mm

Pin Number	Pin Name	Pin orientation	Pin Usage
1	GND	-	Module Ground
2	NC	-	Empty feet (not open for use, no need for users to be concerned)
3	GND	-	Module Ground
4	GND	-	Module Ground
5	TX_EN	output	Used in conjunction with RX_EN to control the external PA; left blank if not used
6	RX_EN	output	Used in conjunction with TX_EN to control the external PA; left blank if not used
7	CLK	input/output	SWCLK Clock pin for program loading (suspended, no user connection required)
8	DIO	input/output	SWDIO data pins for program loading (dangling, no user connection required)

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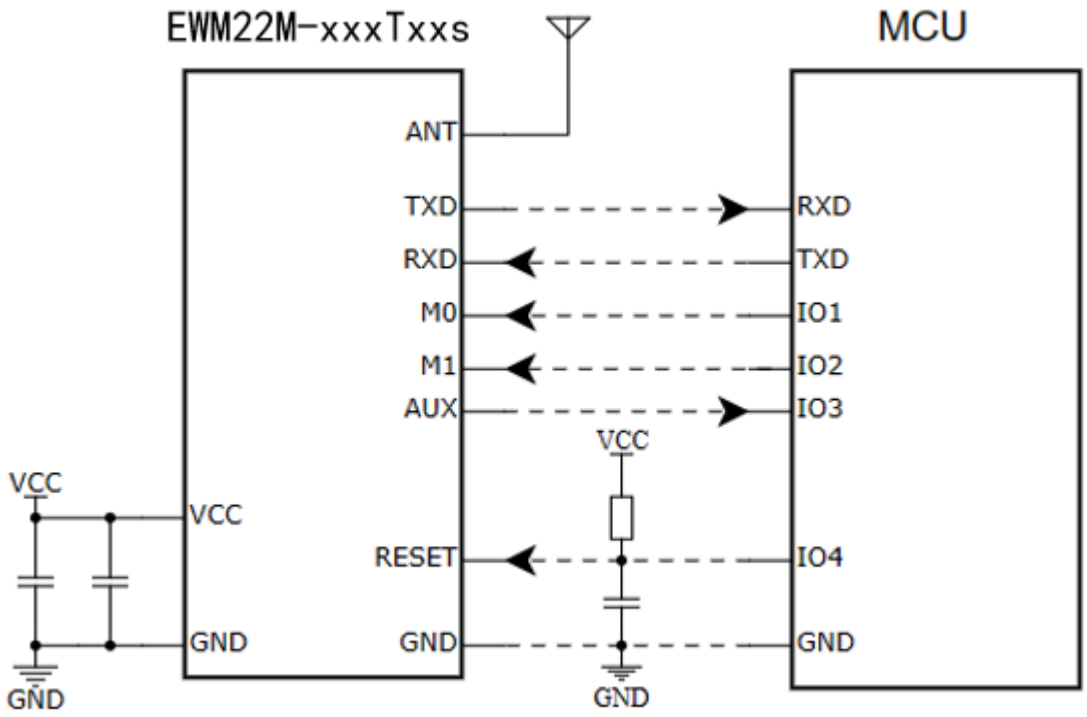
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9	NC	-	Empty feet (not open for use, no need for users to be concerned)
10	NC	-	Empty feet (not open for use, no need for users to be concerned)
11	NC	-	Empty feet (not open for use, no need for users to be concerned)
12	NC	-	Empty feet (not open for use, no need for users to be concerned)
13	GND	-	Module Ground
14	VCC	-	Module power supply positive reference, voltage range: 2.7 to 5.5V DC
15	TXD	output	TTL serial output connected to external RXD output pin;
16	RXD	input	TTL serial input connected to an external TXD output pin;
17	M1	Input	In conjunction with M0, determines the 4 modes of operation of the module (cannot be left unattended, but can be grounded if not in use).
18	M0	Input	In conjunction with the M1, determines the 4 modes of operation of the module (non-hovering, can be grounded if not in use)
19	AUX	output	Used to indicate the working status of the module; the user wakes up the external MCU and outputs a low level during power-on self-test initialisation; (can be suspended)
20	NC	-	Empty feet (not open for use, no need for users to be concerned)
21	RESET	input	Module reset pin, low level reset.
22	GND	-	Module Ground
23	ANT	-	Antenna interface (HF signal output, 50 ohm characteristic impedance)
24	GND	-	Module Ground

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4 Recommended Connectivity Chart



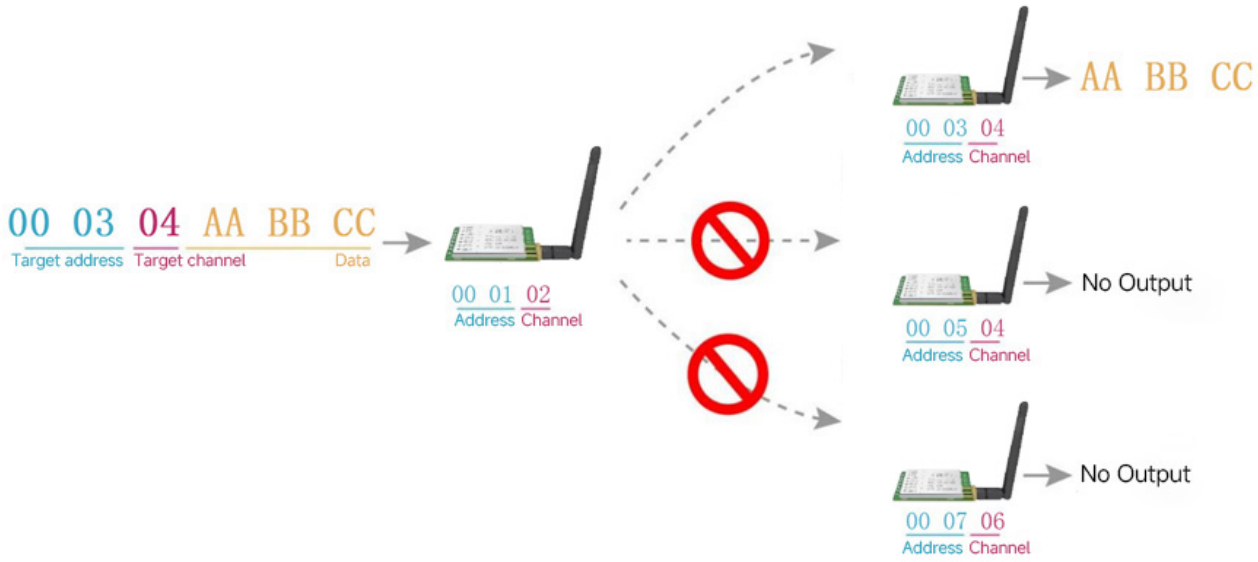
No.	Module and Microcontroller Connection Instructions (The above diagram uses STM8L microcontroller as an example)
1	The wireless serial port module is TTL level, please connect it to a TTL level MCU.
2	For some 5V microcontrollers, 4~10K pull-up resistors may need to be added to the TXD and AUX pins of the module.
3	It is recommended to reserve a 1MΩ pull-up resistor at the M0/M1 interface.

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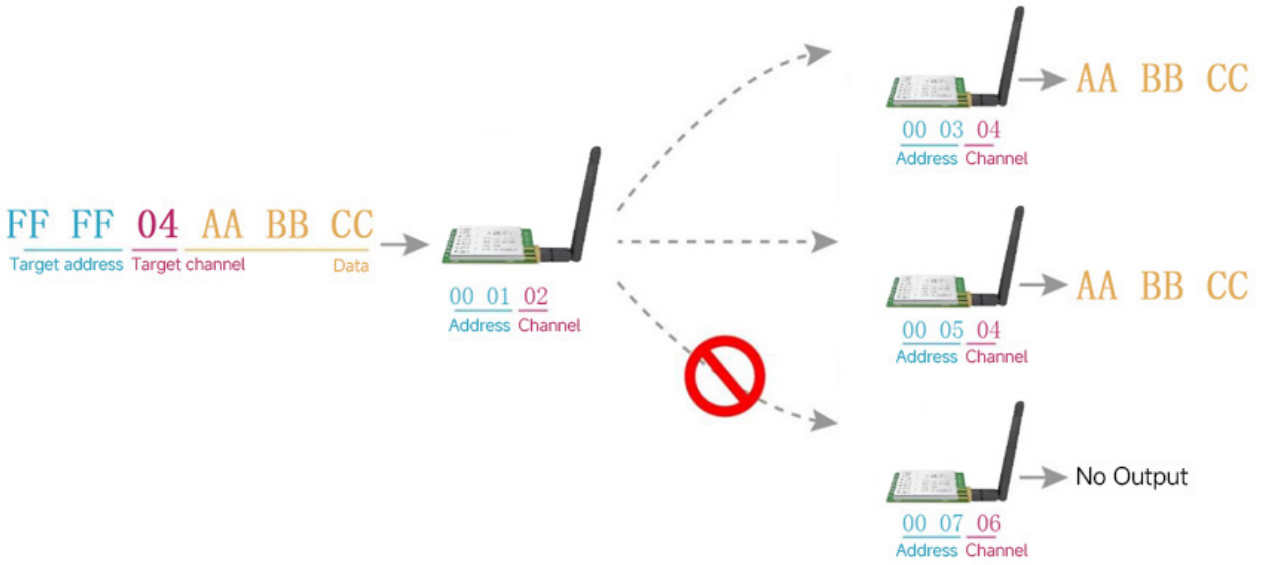
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5 Functions in detail

5.1 Fired at a fixed point



5.2 Broadcast emission



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5.3 Broadcast address

- Example: Set module A address to 0xFFFF and channel to 0x04.
- When module A is used as a transmitter (same mode, transparent transmission method), all receiving modules under channel 0x04 can receive the data for the purpose of broadcasting.

5.4 Listening address

- Example: Set module A address to 0xFFFF and channel to 0x04.
- When module A is used as a receiver, it can receive all the data under channel 0x04 to achieve the purpose of listening.

5.5 Module reset

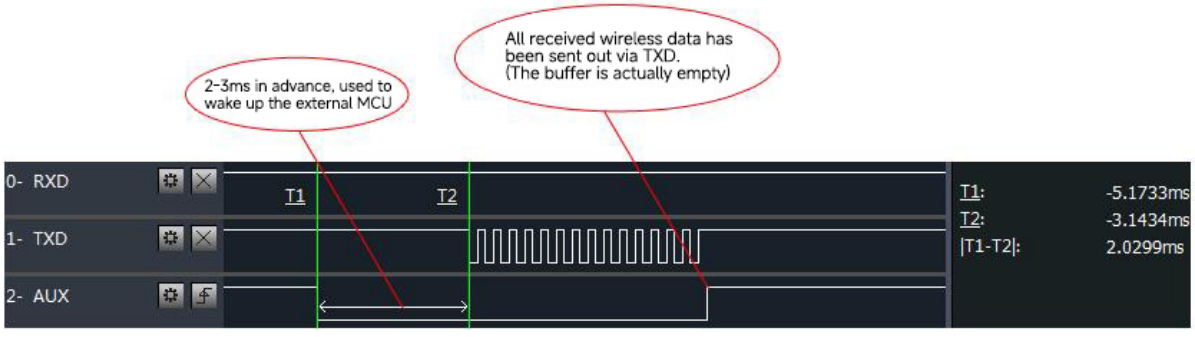
- After the module is powered on, AUX will immediately output a low level, and carry out hardware self-test, as well as set up the working mode according to user parameters;
- During this process, AUX will keep low level, and when it is finished, AUX will output high level and start to work normally according to the working mode combined by M1 and M0;
- Therefore, the user needs to wait for the rising edge of AUX as the starting point of normal operation of the module.

5.6 AUX explained in detail

- AUX is used for wireless transceiver buffer indication and self-test indication.
- It indicates whether the module has data that has not yet been transmitted out through the wireless, or whether the wireless data that has been received has not yet been sent out in full through the serial port, or whether the module is in the process of initialising the self-test.

5.6.1 Serial Data Output Indication

Used to wake up a sleeping external MCU;



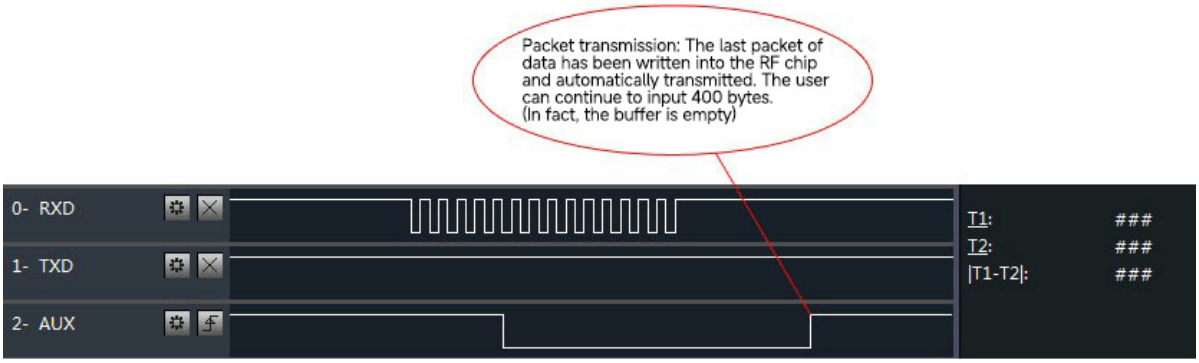
AUX pin timing diagram when the module serial port sends data

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5.6.2 Radio transmission indication

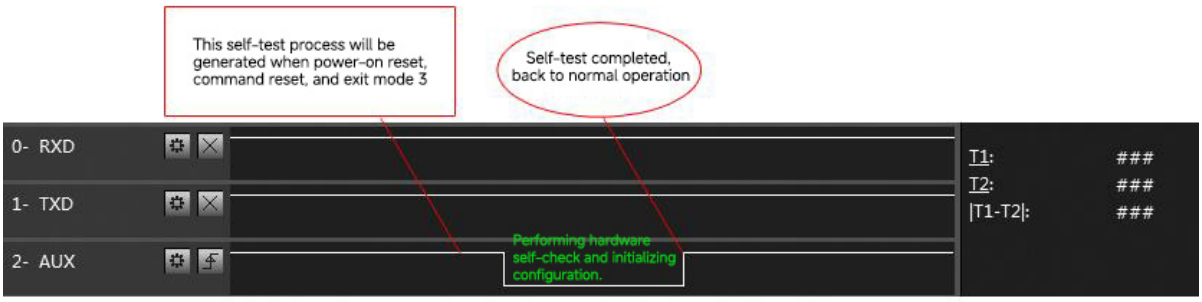
Buffer Empty: the data in the internal 1000 byte buffer are written to the wireless chip (automatic packetisation);
When AUX=1 when the user continuously initiates less than 1000 bytes of data, it will not overflow;
When AUX = 0 when the buffer is not empty: internal 1000 byte buffer data, not yet all written to the wireless chip and open the launch, at this time the module may be waiting for the end of the user's data timeout, or are wireless sub-packet launch.



AUX pin timing diagram when the module receives serial port data

5.6.3 Module is in the process of being configured

Only when resetting and exiting hibernate mode



AUX pin timing diagram during self-test

5.6.4 Precaution

Serial Number	AUX Precautions
1	For function 1 and function 2 above, the output low level takes precedence, i.e.: when any of the output low level conditions are satisfied, the AUX outputs a low level; When all low level conditions are not satisfied, AUX outputs high level.
2	When AUX outputs low level, it means that the module is busy and no working mode detection will be done at this time; When the module AUX outputs high level within 1ms, the mode switching work will be completed.

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3	After the user switches to a new operating mode, at least 2ms after the rising edge of AUX is required for the module to actually enter that mode; If AUX stays high all the time, then the mode switching will take effect immediately.
4	The module resets the user parameters when the user enters from mode 3 (sleep mode) or during a reset, during which the AUX output goes low.
5	Due to the characteristics of LoRa modulation, the information transmission delay is much longer than FSK, such as in 2.4kbps air speed, 100 bytes of transmission delay is about 1.5 seconds, it is recommended that customers do not carry out the transmission of large amounts of data at low air speeds, so as to avoid data loss due to the accumulation of data caused by the communication anomaly.

6 Working mode

The module has four operating modes, which are set by pins M1 and M0; details are shown in the table below:

Mode（0-3）	M1	M0	Introduction of the mode	Notice
0 Transmission mode	0	0	Serial open, wireless open, transparent transmission	Support for special command over-the-air configurations
1 WOR Mode	0	1	Can be defined as WOR sender and WOR receiver	Wake-on-Air support
2 Configuration Mode	1	0	Users can access the registers through the serial port to control the working status of the module.	
3 Deep sleep mode	1	1	Module goes to sleep	

6.1 Mode switching precautions

Serial Number	Notice
1	● Users can combine high and low levels of M1 and M0 to determine the module working mode. The 2 GPIOs of MCU can be used to control the mode switching; ● When changing M1, M0: If the module is idle, after 1ms, it can start working according to the new mode; ● If the module has serial data which has not yet finished transmitting through wireless, it can only enter the new working mode after transmitting; ● If the module receives the wireless data and sends out the data through the serial port, it needs to finish sending out before entering the new working mode; ● So the mode switching can only be effective when AUX outputs 1, otherwise the switching will be delayed.
2	● For example, if the user inputs a large amount of data continuously and switches modes at the same time, the switching mode operation is invalid at this time; the module will process all the user data before detecting a new mode; ● So the general recommendation is: detect the output status of the AUX pin, wait for 2ms after the output high level before switching.

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3	● When the module is switched to sleep mode from other modes, if there is data that has not been processed; ● The module will process these data (both receive and transmit) before entering sleep mode. This feature can be used for fast hibernation to save power consumption; for example: the transmitter module works in mode 0, the user initiates the serial data '12345', and then does not have to wait for the AUX pin to be idle (high), it can be directly switched to hibernation mode and the user's main MCU will be immediately hibernated, and the module will automatically send out the user's data through the wireless all 1ms. automatically go into hibernation within 1ms after the module sends out all the user data through wireless; ● Thus saving the working time of MCU and reducing power consumption.
4	● Similarly, any mode switching can make use of this feature, after the module has processed the current mode event, within 1ms, it will automatically enter the new mode; thus eliminating the need for the user to query the AUX, and can achieve the purpose of fast switching; ● For example, switching from transmitter mode to receiver mode; the user MCU can also enter hibernation before mode switching, and use the external interrupt function to get the AUX change, so as to carry out mode switching.
5	● This operation method is very flexible and efficient, completely designed in accordance with the user's MCU operating convenience, and can minimise the workload of the whole system, improve system efficiency and reduce power consumption.

6.2 General mode (mode 0)

Type	When M0 = 0 and M1 = 0, the module operates in mode 0
Transmit	The user can enter data through the serial port and the module will initiate wireless transmission.
Receive	The module's wireless reception function is turned on, and wireless data will be output via the serial port TXD pin when received.

6.3 WOR mode (mode 1)

Type	When M0 = 1 and M1 = 0, the module operates in mode 1
Transmit	When defined as a transmitter, a wake-up code is automatically added for a certain amount of time before transmitting
Receive	Data can be received normally, reception function is equivalent to mode 0

6.4 Configuration mode (mode 2)

Type	When M0 = 0 and M1 = 1, the module operates in mode 2
Transmit	Wireless transmits off, turns on automatically when wireless is configured

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Receive	Wireless reception off, turns on automatically when wireless is configured
Configure	User access to registers to configure module operating status

6.5 Deep sleep mode (mode 3)

Type	When M0 = 1 and M1 = 1, the module operates in mode 3
Transmit	Unable to transmit wireless data.
Receive	Unable to receive wireless data.
Notice	When entering from hibernation mode, the module will reconfigure the parameters, and AUX stays low during the configuration process; When finished, it outputs a high level, so it is recommended that the user detects the rising edge of AUX.

7 Register read/write control

7.1 Command format

The list of supported commands in the configuration mode (Mode 2: M1=1, M0=0) is as follows (only 9600, 8N1 format is supported during setup):

Serial number	Command format	Eplanation
1	Setup Registers	Instruction: C0 + start address + length + parameters Response: C1 + start address + length + parameters Example 1: Configure the channel as 0x09 Command Start address Length Parameters Send：C0 05 01 09 Return: C1 05 01 09 Example 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1) and airspeed (2.4K) at the same time Send: C0 00 04 12 34 00 62 Return: C1 00 04 12 34 00 62
2	Read registers	Command: C1 + start address + length Response: C1 + start address + length + parameters Example 1: Read channel Command Start address Length Parameters Send: C1 05 01 Return: C1 05 01 09 Example 2: Read module address, network address, serial port, airspeed at the same time

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		Send: C1 00 04 Return: C1 00 04 12 34 00 61
3	Setting Temporary Registers	Command: C2 + start address + length + parameters Response: C1 + start address + length + parameters Example 1: Configure the channel as 0x09 Command Start address Length Parameters Send: C2 05 01 09 Return: C1 05 01 09 Example 2: Configure module address (0x1234), network address (0x00), serial port (9600 8N1), and airspeed (2.4K) simultaneously Send: C2 00 04 12 34 00 62 Return: C1 00 04 12 34 00 62
4	Wireless Configuration	Command: CF CF + regular command Response: CF CF + regular response Example 1: Wireless configuration channel is 0x09 Wireless Command Header Command Start Address Length Parameters Send: CF CF C0 05 01 09 Return: CF CF C1 05 01 09 Example 2: Wireless configure module address (0x1234), network address (0x00), serial port (9600 8N1), airspeed (2.4K) at the same time. Send: CF CF C0 00 04 12 34 00 62 Return: CF CF C1 00 04 12 34 00 62
5	Formatting error	Format Error Response FF FF FF

7.2 EWM22M-400/900T22S Register Description

<table>
<tr><th>Serial Number</th><th>Read/ Write</th><th>Name</th><th colspan="4">Description</th><th>Notice</th></tr>
<tr><td>00H</td><td>Read/ Write</td><td>ADDH</td><td colspan="4">ADDH（default 0）</td><td rowspan="2">Module address high byte and low byte;
Note: When the module address is equal to FFFF, it can be used as a broadcast and listening address, i.e.: at this point the module will not perform address filtering</td></tr>
<tr><td>01H</td><td>Read/ Write</td><td>ADDL</td><td colspan="4">ADDL（default 0）</td></tr>
<tr><td>02H</td><td>Read/ Write</td><td>NETID</td><td colspan="4">NETID（default 0）</td><td>Network address for distinguishing networks; When communicating with each other, they should be set to the same.</td></tr>
<tr><td rowspan="4">03H</td><td rowspan="4">Read/ Write</td><td rowspan="4">EG0</td><td>7</td><td>6</td><td>5</td><td>UART serial port rate（bps）</td><td rowspan="4">Two modules communicating with each other, the serial port baud rate can be different, and the checksum method can also be different;

When transmitting larger data packets continuously, the user needs to consider the data blocking brought by the same baud rate, and may even be lost;</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>The serial port baud rate is 1200</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>The serial port baud rate is 2400</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>The serial port baud rate is 4800</td></tr>
</table>

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			0	1	1	The serial port baud rate is 9600（default）	It is generally recommended that the baud rates of the two communicating parties are the same.
			1	0	0	The serial port baud rate is 19200	
			1	0	1	The serial port baud rate is 38400	
			1	1	0	The serial port baud rate is 57600	
			1	1	1	The serial port baud rate is 115200	
			4	3	serial port parity bit		The serial port modes can be different on both sides of the communication;
			0	0	8N1（default）		
			0	1	8O1		
			1	0	8E1		
			1	1	8N1（Equivalent to 00）		
			2	1	0	wireless airspeed（bps）	The air rate must be the same on both sides of the communication; The higher the air rate, the lower the delay and the shorter the transmission distance.
			0	0	0	airspeed 2.4k	
			0	0	1	airspeed 2.4k	
			0	1	0	airspeed 2.4k（default）	
			0	1	1	airspeed 4.8k	
			1	0	0	airspeed 9.6k	
			1	0	1	airspeed 19.2k	
			1	1	0	airspeed 38.4k	
			1	1	1	airspeed 62.5k	
04H	Read/ Write	REG1	7	6	Subcontracting Settings		If the data sent by the user is less than the packet length, the output of the serial port at the receiving end is presented as uninterrupted continuous output; If the data sent by the user is larger than the packet length, the serial port at the receiving end will output in packets.
			0	0	240 bytes（default）		
			0	1	128 bytes		
			1	0	64 bytes		
			1	1	32 bytes		
			5	RSSI Environmental Noise Enable			When enabled, command C0 C1 C2 C3 can be sent in transmit mode or WOR transmit mode Command Read Register; Register 0x00 : Current ambient noise RSSI; Register 0X01 : RSSI of last received data. (The current channel noise is: dBm = -(256 - RSSI)); Instruction format: C0 C1 C2 C3 + start address + read length; Return: C1 + address + read length + read the effective value; such as: send C0 C1 C2 C3 00 01 Return C1 00 01 RSSI**(Addresses can only start at 00)**
			0	Disable (default)			
			1	enable			
			4	Software mode switching			**If the parameters are configured using our host computer, the bit is actively switched**
			0	Disable (default)			

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<table>
<tr><td></td><td></td><td></td><td colspan="3">1 enable</td><td>off.
Do not want to use the M0 M1 pin to switch the working mode, you can enable this function and use specific serial commands to switch the mode.
Format: C0 C1 C2 C3 02 + Operating Mode
Send C0 C1 C2 C3 02 00 to switch to pass-through mode.
Send C0 C1 C2 C3 02 01 to switch to WOR mode.
Send C0 C1 C2 C3 02 02 to switch to configuration mode
Send C0 C1 C2 C3 02 03 Switch to sleep mode
Return: C1 C2 C3 02 + WOR mode
Note: When this function is enabled, WOR mode and sleep mode only support 9600 baud rate.</td></tr>
<tr><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td><td>3</td><td>2</td><td>retention</td><td></td></tr>
<tr><td>1</td><td>0</td><td>firing power</td><td rowspan="5">Power and current are non-linearly related, and the power supply is most efficient at maximum power;

Current does not decrease in the same proportion as power decreases.</td></tr>
<tr><td>0</td><td>0</td><td>22dBm（default）</td></tr>
<tr><td>0</td><td>1</td><td>17dBm</td></tr>
<tr><td>1</td><td>0</td><td>13dBm</td></tr>
<tr><td>1</td><td>1</td><td>10dBm</td></tr>
<tr><td>05H</td><td>Read/ Write</td><td>REG2</td><td colspan="3">channel control（CH）
0-83 represent a total of 84 channels (for the 400 band).
0-80 represent a total of 81 channels respectively (for 900 band)</td><td>Actual frequency = 410.125 + CH * 1M
Actual Frequency = 850.125 + CH * 1M</td></tr>
<tr><td rowspan="11">06H</td><td rowspan="11">Read/ Write</td><td rowspan="11">REG3</td><td>7</td><td colspan="2">Enable RSSI bytes</td><td rowspan="3">When enabled, the module receives wireless data, which will follow an RSSI intensity byte when output through the serial port TXD.</td></tr>
<tr><td>0</td><td colspan="2">Disable (default)</td></tr>
<tr><td>1</td><td colspan="2">Enable</td></tr>
<tr><td>6</td><td colspan="2">transmission method</td><td rowspan="3">For fixed-point transmission, the module identifies the first three bytes of the serial data as: address high + address low + channel, and uses them as the wireless transmit target.</td></tr>
<tr><td>0</td><td colspan="2">Transparent transmission (default)</td></tr>
<tr><td>1</td><td colspan="2">fixed-point transmission</td></tr>
<tr><td>5</td><td colspan="2">relay function</td><td rowspan="3">When the relay function is enabled, the module will initiate a forwarding if the destination address is not the module itself; In order to prevent data backhauling, it is recommended to be used in conjunction with fixed-point mode; i.e., the destination address is different from the source address.</td></tr>
<tr><td>0</td><td colspan="2">Disable relay function (default)</td></tr>
<tr><td>1</td><td colspan="2">Enable relay function</td></tr>
<tr><td>4</td><td colspan="2">LBT Enable</td><td rowspan="2">When enabled, wireless data will be listened to before transmitting, which can avoid</td></tr>
<tr><td>0</td><td colspan="2">Disable (default)</td></tr>
</table>

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<table>
<tr><td rowspan="14"></td><td rowspan="14"></td><td rowspan="14"></td><td>1</td><td colspan="3">Enable</td><td>interference to some extent, but may bring data delay;

The maximum dwell time of LBT is 2 seconds, and it will be forced to send out when it reaches two seconds.</td></tr>
<tr><td>3</td><td colspan="3">WOR mode transceiver control</td><td rowspan="3">Valid only for mode 1;
1. wor's receive mode, the module can modify the delay time after wake-up, the default time is 0;
2. the receiver needs to send the command C0 09 02 03 E8 in the configuration mode (C0 is the write command, 09 is the address of the register initiator, 02 is the length, 03 E8 is the delay time set, the maximum FFFF that is 65535ms, and setting it to 0 closes the wake-up delay time).
3. Data can be sent within the delay time.</td></tr>
<tr><td>0</td><td colspan="3">WOR receiver (default)
Working in WOR listening mode with the listening period described below (WOR period) saves significant power consumption.</td></tr>
<tr><td>1</td><td colspan="3">WOR Transmitter
The module transmits and receives on and adds a wake-up code for a certain period of time when transmitting data.</td></tr>
<tr><td>2</td><td>1</td><td>0</td><td>WOR cycle</td><td rowspan="10">Valid only for mode 1;

Cycle time T= (1+WOR)*500ms, maximum 4000ms, minimum 500ms;

The longer the period time between WOR listening intervals, the lower the average power consumption, but the higher the data delay;

Both sender and receiver must agree (very important)</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>500ms</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1000ms</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1500ms</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>2000ms</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>2500ms</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>3000ms</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>3500ms</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>4000ms</td></tr>
<tr><td>07H</td><td>Write</td><td>CRYPT_H</td><td colspan="4">Key high byte (default 0)</td><td rowspan="2">Write only, read returns 0;
Used for encryption to avoid interception of over-the-air wireless data by similar modules;
The module will internally use these two bytes as a calculation factor to transform and encrypt the over-the-air wireless signal.</td></tr>
<tr><td>08H</td><td>Write</td><td>CRYPT_L</td><td colspan="4">Key low byte (default 0)</td></tr>
<tr><td>80H～86H</td><td>Read</td><td>PID</td><td colspan="4">7 bytes of product information</td><td>7 bytes of product information</td></tr>
</table>

7.3 Factory Default Parameters

Model	**EWM22M-400T22S Factory Default Parameter Values：C0 00 09 00 00 00 62 00 17 03 00 00** **EWM22M-900T22S Factory Default Parameter Values：C0 00 09 00 00 00 62 00 12 03 00 00**						
Module model	Frequency	Address	Channel	Airspeed	Braud Rate	Serial Port Format	Firing Power
EWM22M-400T22S	433.125MHz	0x0000	0x17	2.4kbps	9600	8N1	22dbm
EWM22M-900T22S	868.125MHz	0x0000	0x12	2.4kbps	9600	8N1	22dbm

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8 AT Command

- Using AT instructions for parameter configuration or querying needs to be done in the configuration mode;
- AT commands are used in the configuration mode. AT commands are divided into three categories in total: command commands, setup commands and query commands;
- Users can use 'AT+HELP=?' Users can query the AT instruction set supported by the module through 'AT+HELP=?', and the baud rate adopted by AT instruction is 9600 8N1;
- When the input parameter exceeds the range, it will be restricted, please do not let the parameter exceed the range to avoid unknown situation.

8.1 AT command table

Command instruction	Descriptions	Example	Example Description
AT+IAP(Use caution, see this article for details 8.3 Serial Port Upgrade Firmware Precautions)	Enter IAP upgrade mode	AT+IAP	Enter IAP upgrade mode
AT+RESET	Device reboot	AT+RESET	Device reboot
AT+DEFAULT	Configuration parameters are restored to default and the device reboots	AT+DEFAULT	Configuration parameters are restored to default and the device reboots

Command instruction	Descriptions	Example	Example Description
AT+UART=baud,parity	Set baud rate and parity	AT+UART=3,0	Set baud rate to 9600, 8N0
AT+RATE=rate	Setting the airspeed	AT+RATE=7	Set air rate to 62.5K/15.6
AT+PACKET=packet	Set packet length	AT+PACKET=0	Set packet to 240 bytes
AT+WOR=role	Setting up WOR roles	AT+WOR=0	Set to receive WOR
AT+POWER=power	Setting the transmission power	AT+POWER=0	Set the transmit power to 22dBm
AT+TRANS=mode	Setting the sending mode	AT+TRANS=1	Set to fixed point mode
AT+ROUTER=router	Setting the relay mode	AT+ROUTER=1	Set to relay mode
AT+LBT=lbt	Setting the Listen Before Talk function switch	AT+LBT=1	Set on, refer to section 7.2 LBT enable for details.
AT+ERSSI=erssi	Setting the ambient noise RSSI switch	AT+ERSSI=1	Set on, refer to section 7.2 RSSI ambient noise function for details
AT+DRSSI=data_rssi	Setting the receive data RSSI switch	AT+DRSSI=1	Receive data RSSI function on
AT+ADDR=addr	Setting Module Address	AT+ADDR=1234	Set the module address to 1234
AT+CHANNEL=channel	Setting the module	AT+CHANNEL=23	Set the frequency to 433.125M

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	operating channel		
AT+NETID=netid	Setting the Network ID	AT+NETID=2	Set the network ID to 2
AT+KEY=key	Setting the Module Key	AT+KEY=1234	Set the module key to 1234
AT+DELAY=delay	Setting the WOR delayed sleep time	AT+DELAY=1000	Set WOR delayed sleep time to 1000ms
AT+SWITCH=switch	Setting the software toggle mode switch	AT+SWITCH=1	Setting on in configuration mode allows software switching.
AT+MODE=mode	Switching operating modes	AT+MODE=0	Switch to pass-through mode
AT+URXT= <urxt>	Setting the serial port to receive packet break bytes	AT+URXT=3	Set serial port 3-byte subpacket. <urxt>=1~255

Command instruction	Descriptions	Example	Example Description
AT+HELP=?	Query AT command table		Return to the AT command table
AT+DEVTYPE=?	Query Module Model	DEVTYPE=EWM22M-400T22S/D	Return to Module Models
AT+FWCODE=?	Query Firmware Code	FWCODE=7432-0-10	Return to Firmware Version
AT+UART=?	Query baud rate and checksum	AT+UART=3,0	Returns baud rate of 9600, 8N1
AT+RATE=?	Query airspeed	AT+RATE=7	Return air rate of 62.5K
AT+PACKET=?	Query Packet Length	AT+PACKET=0	Return packet is 240 bytes
AT+WOR=?	Query WOR roles and cycles	AT+WOR=0	Returns as WOR receive
AT+POWER=?	Query Transmit Power	AT+POWER=0	Returns transmit power of 22dBm
AT+TRANS=?	Query Send Mode	AT+TRANS=1	Returns to fixed-point mode
AT+ROUTER=?	Query Relay Mode	AT+ROUTER=1	Return to relay mode
AT+LBT=?	Query Listen Before Talk function switch	AT+LBT=1	Return to LBT switching status
AT+ERSSI=?	Enquire about ambient noise RSSI switch	AT+ERSSI=1	Return to Ambient Noise Switch Status
AT+DRSSI=?	Query RSSI output	AT+DRSSI=1	Return channel RSSI function on
AT+ADDR=?	Query Module Address	AT+ADDR=1234	Returns the module address to 1234
AT+CHANNEL=?	Query module operating channel	AT+CHANNEL=23	Return frequency is 433.125M
AT+NETID=?	Query Network ID	AT+NETID=2	Returns the network ID as 2
AT+KEY=?	Query Module Key	Reading is not supported (security considerations)	Return ERR
AT+DELAY=?	Query WOR delayed	AT+DELAY=1000	Returns WOR delayed sleep

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	hibernation time		time of 1000ms
AT+SWITCH=?	Query software switching mode switch	AT+SWITCH=0	Software switching mode off
AT+MODE=?	Query the current working mode (all modes can be queried)	AT+MODE=0	Returns the current pass-through mode

8.2 Analysis of AT parameters

When the serial port receives the correct command, the serial port will return 'Command = OK', otherwise it will return '=ERR'.

Command parameter	Meaning of a parameter
Baud（serial port baud rate）	0:1200 1:2400 2:4800 3:9600 4:19200 5:38400 6:57600 7:115200
Parity（serial port parity bit）	0:8N1 1:8O1 2:8E1 3:8N1
Rate（airspeed） Suitable for 400MHz band and 900MHz band	0:2.4K 1:2.4K 2:2.4K 3:4.8K 4:9.6K 5:19.2K 6:38.4K 7:62.5K
Rate（airspeed） Suitable for 230MHz band	0:2.4K 1:2.4K 2:2.4K 3:2.4K 4:4.8K 5:9.6K 6:15.6K 7:15.6K
Packet（Packet length）	0:240 1:128 2:64 3:32
Role（WOR Role）	0:Receive 1:Send
Period（WOR cycle）	0:500ms 1:1000ms 2:1500ms 3:2000ms 4:2500ms 5:3000ms 6:3500ms 7:4000ms
Power（firing power）note 1	0:22dBm 1:20dBm 2:17dBm 3:14dBm
Mode（transfer mode）	0:Transparent 1:Fixed point
Router（relay mode）	0:off 1:on
LBT(listen before talk)	0:off 1:on
Erssi(Environmental RSSI)	0:off 1:on
Data_rssi（Data RSSI）	0:off 1:on
Addr（module address）	Module address 0 to 65535 (decimal)
Channel（module channel）	Module channel 0 to 83 (decimal)
Netid（Network ID）	Module network 0~255 (decimal)
Key（keys）	Module key 0~65535 (decimal)
Delay（WOR time-delayed hibernation）	Delayed sleep 0~65535 (decimal)

Note 1: Module settings are different for different power levels, see section 7.2 Transmitter Power in the manual.

8.3 Notes on serial port firmware upgrade

If customers need to upgrade the firmware, they need to find the corresponding BIN file provided by the official, and then use the upper computer provided by the official to upgrade the firmware, generally users do not need to upgrade the

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firmware, please do not use the 'AT+IAP' command.

The necessary pins for upgrading must be pinned out (M1, M0, AUX, TXD, RXD, VCC, GND), and then send 'AT+IAP' command to enter the upgrade mode in the configuration mode, if you need to exit the IAP upgrade mode, you need to keep the power on and wait for 60 seconds, and the programme will be automatically exited, or else it will enter the upgrade mode indefinitely even if it is rebooted. If you need to exit IAP upgrade mode, you need to keep power on and wait for 60 seconds, the programme will exit automatically, otherwise, even if you reboot, it will enter upgrade mode indefinitely.

After entering the upgrade mode, the baud rate will be automatically switched to 115200 until it exits automatically, during which a log will be output.

9 Relay Networking Mode Usage

Serial number	Description of trunking mode
1	After setting the relay mode through the configuration mode, switch to the general mode and the relay starts working.
2	In relay mode ADDH,ADDL are no longer used as module address, but correspond to NETID to forward pairing respectively, and if one of the networks is received, it will be forwarded to the other network; The repeater's own network ID is invalid.
3	In relay mode, the relay module cannot send and receive data for low-power operation.
4	The module resets the user parameters when the user enters from mode 3 (sleep mode) or during a reset, during which the AUX output goes low.

Description of relay networking rules:

1, forwarding rules, relay can forward data in both directions between two NETIDs.

2. In relay mode, ADDH\ADDL is no longer used as a module address and is forwarded as a NETID pair.

As shown in the figure:

① primary relay

'Node 1' NETID is 08.

'Node 2' NETID is 33.

The ADDH\ADDL of relay 1 is 08, 33 respectively.

So the signal sent by node 1 (08) can be forwarded to node 2 (33)

Meanwhile, node 1 and node 2 have the same address, so the data sent by node 1 can be received by node 2.

② Secondary Relay

The ADDH\ADDL of relay 2 is 33, 05 respectively.

So relay 2 can forward the data of relay 1 to network NETID: 05.

Thus node 3 and node 4 can receive node 1 data. Node 4 outputs data normally, and node 3 has a different address from node 1, so it does not output data.

③ Bidirectional Relay

As configured in the figure: the data sent by node 1 can be received by nodes 2 and 4, and the data sent by nodes 2 and 4 can be received by node 1.

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10 Configuration instructions for the host computer

The following figure shows the display interface of the configuration upper computer of EWM22M-900T22D as an example. Users can switch to the command mode through M0 and M1 for quick configuration and reading of parameters in the upper computer.



In the Configuration Upper, the module address, frequency channel, network ID, and key are in decimal display mode; where each parameter takes a range of values:

Network address: 0～65535

Frequency channel: 0～80

Network ID: 0～255

Key: 0～65535

Users need to pay special attention when using the upper computer to configure the relay mode, because in the upper computer, each parameter is decimal display mode, so the module address and network ID need to be filled in by converting the system;

For example, if the network ID inputted by transmitter A is 02, and the network ID inputted by receiver B is 10, then when relay R sets the module address, it will convert the hexadecimal value of 0X020A to the decimal value of 522 as the module address filled by relay R. In other words, at this time, relay R needs to fill in the module address; That is, at this time, the relay R needs to fill in the module address value of 522.

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11 Hardware design

- It is recommended to use a DC regulated power supply to power the module, the power supply ripple factor is as small as possible, the module needs to be reliably grounded;
- Please pay attention to the correct connection of the positive and negative terminals of the power supply, if reversed it may cause permanent damage to the module;
- Please check the power supply to ensure that it is between the recommended supply voltages, if it exceeds the maximum value it may cause permanent damage to the module;
- Check the stability of the power supply to ensure that the voltage does not fluctuate significantly and frequently;
- When designing the power supply circuit for the module, it is often recommended to keep more than 30% of the residual capacity, and have the whole machine is conducive to long-term stable operation;
- Module should be as far away as possible from the power supply, transformers, high-frequency alignments and other electromagnetic interference in the larger part;
- High-frequency digital alignment, high-frequency analogue alignment, power supply alignment must be avoided below the module, if you really need to go through the bottom of the module, assuming that the module is welded in the Top Layer, the Top Layer in the contact part of the module to pave the ground copper (all paved with copper and a good ground), it must be close to the digital part of the module and the alignment in the Bottom Layer;
- Assuming that the module is soldered or placed in the Top Layer, it is also wrong to route the wires randomly in the Bottom Layer or other layers, which will affect the spuriousness of the module as well as the reception sensitivity in different degrees;
- Assuming that there is a large electromagnetic interference around the module device will also greatly affect the performance of the module, according to the intensity of the interference is recommended to stay away from the module, if the situation permits you can do appropriate isolation and shielding;
- Assuming that there is a large electromagnetic interference around the module alignment (high-frequency digital, high-frequency analogue, power supply alignment) will also greatly affect the performance of the module, according to the intensity of the interference is recommended to be appropriate away from the module, if the situation permits you can do appropriate isolation and shielding;
- If the communication line uses 5V level, it must be connected in series with 1k-5.1k resistor (not recommended, there is still a risk of damage);
- Try to stay away from some of the physical layer is also 2.4GHz TTL protocol, such as: USB3.0;
- The antenna mounting structure has a big impact on the module performance, make sure the antenna is exposed and preferably vertically upwards;
- When the module is installed inside the chassis, you can use a good quality antenna extension cable to extend the antenna to the outside of the chassis;
- The antenna must not be installed inside the metal case, which will result in the transmission distance being greatly weakened.

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12 FAQ

12.1 Unsatisfactory transmission distance

- When there are linear communication barriers, the communication distance will be attenuated accordingly;
- Temperature, humidity, and co-frequency interference, which will lead to an increase in the communication packet loss rate;
- The ground absorbs and reflects radio waves, and the test effect is poor near the ground;
- Seawater has a strong ability to absorb radio waves, so the seaside test effect is poor;
- There are metal objects near the antenna, or placed in a metal shell, the signal attenuation will be very serious;
- Incorrect power register setting, air rate setting is too high (the higher the air rate, the closer the distance);
- The low voltage of the power supply at room temperature is lower than the recommended value, the lower the voltage, the lower the hair power;
- The antenna is poorly matched to the module or the antenna itself is of poor quality.

12.2 Modules are fragile

- Please check the power supply to ensure that it is between the recommended supply voltages, if it exceeds the maximum value it will cause permanent damage to the module;
- Please check the stability of the power supply, the voltage can not be large and frequent fluctuations;
- Please ensure that the installation and use of the process of anti-static operation, high-frequency devices electrostatic sensitivity;
- Please ensure that the installation and use of the process of humidity should not be too high, part of the components for humidity-sensitive devices;
- If there is no special demand is not recommended in too high, too low temperature use.

12.3 BER is too high

- Nearby there is the same frequency signal interference, away from the source of interference or modify the frequency and channel to avoid interference;
- Unsatisfactory power supply may also cause garbled code, be sure to ensure the reliability of the power supply;
- Extension cables, feeder cables of poor quality or too long, can also cause high BER.

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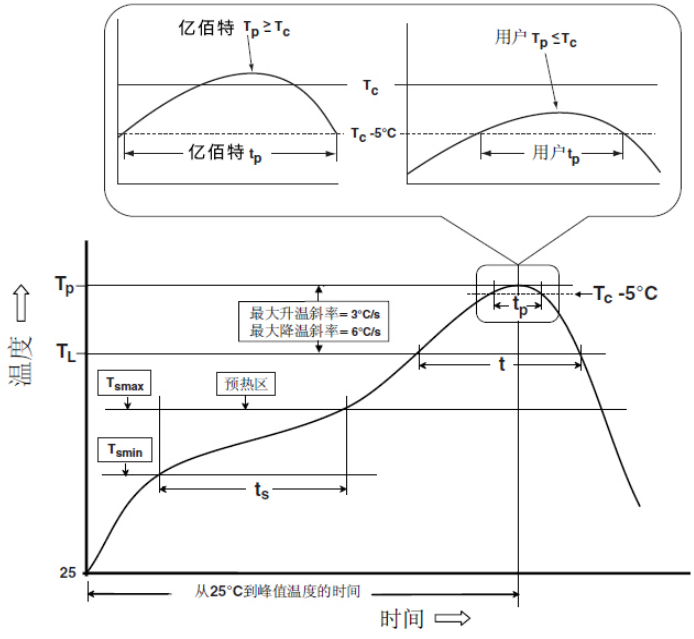
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13 Welding instructions

13.1 Reflow temperature

Reflow Profile Characteristics		Leaded process assembly	Lead-free process assembly
Preheating/Holding	minimum temperature（Tsmin）	100℃	150℃
	highest temperature（Tsmax）	150℃	200℃
	Time（Tsmin~Tsmin）	60-120 seconds	60-120 seconds
slope of temperature rise（TL~Tp）		3°C/sec, max.	3°C/sec, max.
liquid-phase temperature（TL）		183℃	217℃
Holding time above TL		60~90 seconds	60~90 seconds
Peak package temperature Tp		The user must not exceed the temperature indicated on the product's ‘Moisture Sensitivity’ label.	The user must not exceed the temperature indicated on the product's ‘Moisture Sensitivity’ label.
Time (Tp) within 5°C of the specified classification temperature (Tc), see the following diagram		20 seconds	30 seconds
slope of cooling（Tp~TL）		6°C/sec, max.	6°C/sec, max.
Time from room temperature to peak temperature		6 minutes, max.	8 minutes, max.
※The peak temperature (Tp) tolerance of the temperature profile is defined as the upper limit for the user			

13.2 Reflow temperature



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14 Related Models

Product Model	frequency Hz	Firing power dBm	Test Distance km	Package form	Size mm	communications interface
E22-230T22S	230M	22	5	SMD	16*26	TTL
E22-230T30S	230M	30	10	SMD	20*40.5	TTL
E22-400T22S	433/470M	22	5	SMD	16*26	TTL
E22-400T30S	433/470M	30	10	SMD	20*40.5	TTL
E22-900T22S	868/915M	22	5	SMD	16*26	TTL
E22-900T30S	868/915M	30	10	SMD	20*40.5	TTL
E22-400M22S	433/470M	22	7	SMD	14*20	SPI
E22-400M30S	433/470M	30	12	SMD	24*38.5	SPI
E22-900M22S	868/915M	22	7	SMD	14*20	SPI
E22-900M30S	868/915M	30	12	SMD	24*38.5	SPI

15 Antenna Guide

15.1 Antenna Recommendations

Antenna is an important role in the communication process, often poor-quality antenna will have a great impact on the communication system, so we recommend some of the antennas as a supporting our wireless module and the performance is more excellent and reasonably priced antenna.

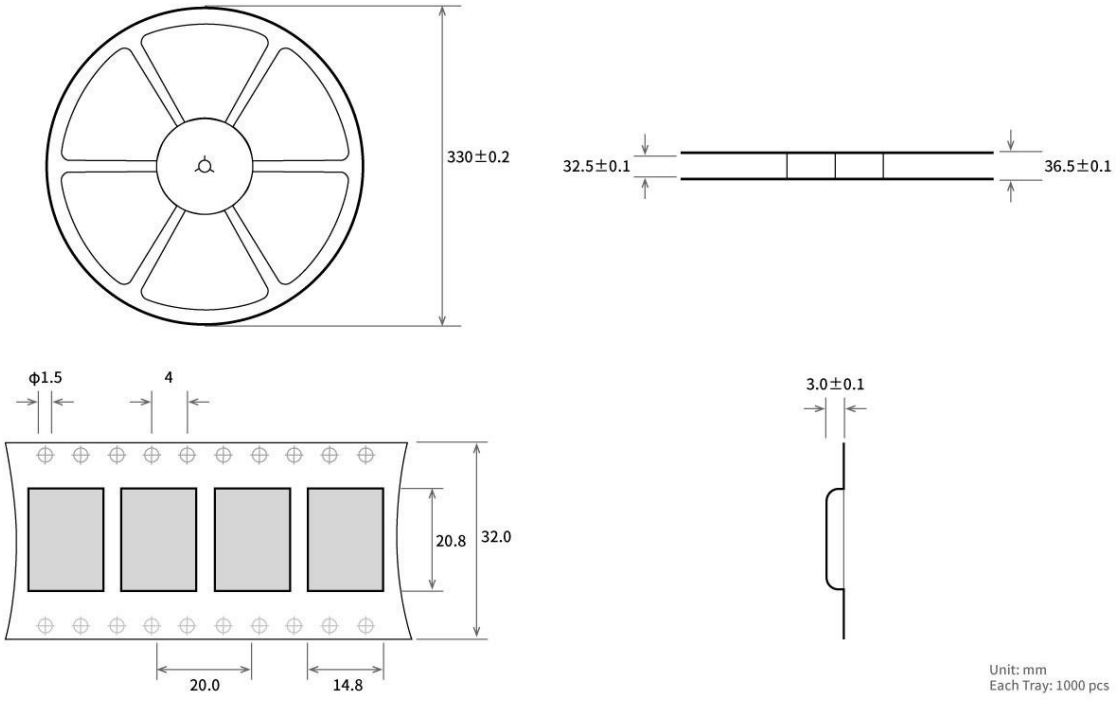
Product model	Type	Frequency Hz	Interface	Gain dBi	Height mm	Feeder cm	Functional features
TX433-NP-4310	Flexible Antenna	433M	soldered	2.0	43.8*9.5	-	Built-in flexible, FPC soft antenna
TX433-JZ-5	glue stick antenna	433M	SMA-J	2.0	52	-	Ultra Short Straight, Omni-Directional Antenna

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TX433-JZG-6	glue stick antenna	433M	SMA-J	2.5	62	-	Ultra Short Straight, Omni-Directional Antenna
TX433-JW-5	glue stick antenna	433M	SMA-J	2.0	50	-	Bending Rubber Stick, Omni-Directional Antenna
TX433-JWG-7	glue stick antenna	433M	SMA-J	2.5	75	-	Bending Rubber Stick, Omni-Directional Antenna
TX433-JK-11	glue stick antenna	433M	SMA-J	2.5	110	-	Bendable Rubber Stick, Omnidirectional Antenna
TX433-JK-20	glue stick antenna	433M	SMA-J	3.0	210	-	Bendable Rubber Stick, Omnidirectional Antenna
TX433-XPL-100	suction cup antenna	433M	SMA-J	3.5	185	100	Small suction cup antenna, cost-effective
TX433-XP-200	suction cup antenna	433M	SMA-J	4.0	190	200	Neutral suction cup antenna, low loss
TX433-XPH-300	suction cup antenna	433M	SMA-J	6.0	965	300	Large suction cup antenna, high gain
TX490-JZ-5	glue stick antenna	470/490 M	SMA-J	2.0	50	-	Ultra Short Straight, Omni-Directional Antenna
TX490-XPL-100	suction cup antenna	470/490 M	SMA-J	3.5	120	100	Small suction cup antenna, cost-effective

16 Batch packing method



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Revision history

Version	Revision date	Revised description	Maintainer
1.0	2024-12-26	Initial version	Lei
1.1	2025-02-17	Add a description of the 1MΩ pull-up resistor reserved at the M0/M1 interface.	Lei

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